NAWC-TSD

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11 December 1997

DIS-HLA Lessons Learned Report
ARCHITECTURE ISSUES FOR DIS-TO-HLA CONVERSION

Naval Air Warfare Center Training Systems Division

[NAWCTSD - HLA RESEARCH AND DEVELOPMENT TEAM]

Orlando, FL

SIMULATION MIDDLEWARE OBJECT CLASSES (SMOC)

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NAWCTSD, Code 4.9.2.2

DIS-HLA Lessons Learned Report

- BACKGROUND
- NAWCTSD SIMULATION MIDDLEWARE OBJECT
  - CLASSES (SMOC)
- SMOC ARCHITECTURE
- TESTING
- SMOC USES
- INSIGHTS / LESSONS LEARNED

Background

- **3 Phases of Research**
  - Pre-Implementation
  - Implementation
  - Results/Lessons Learned
- **4 Focus Areas:**
  - HLA Rules of Usage
  - HLA Interface Specification
  - OMT (SOM & FOM)
  - HLA Gateway

- **HLA Gateway**
  - separate 6.2 effort
  - translator approach
  - scaleable DIS research
- **Simulation Middleware**
- **Object Classes (SMOC)**
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- **NAWCTSD HLA Effort:**
  - I/ITSEC HLA Demo

Result: Product is a complete"middleware" or "gateway" solution for HLA transitions
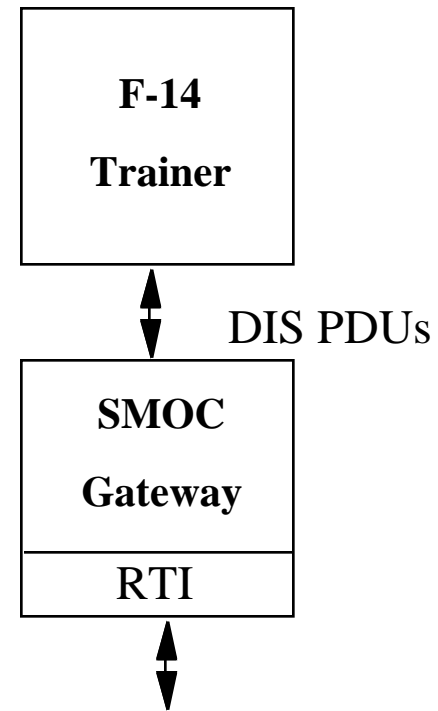
Simulation Middleware
Object Classes (SMOC)

Middleware Mode

Gateway Mode

F-14

Trainer

DIS PDUs

SMOC

Gateway

RTI

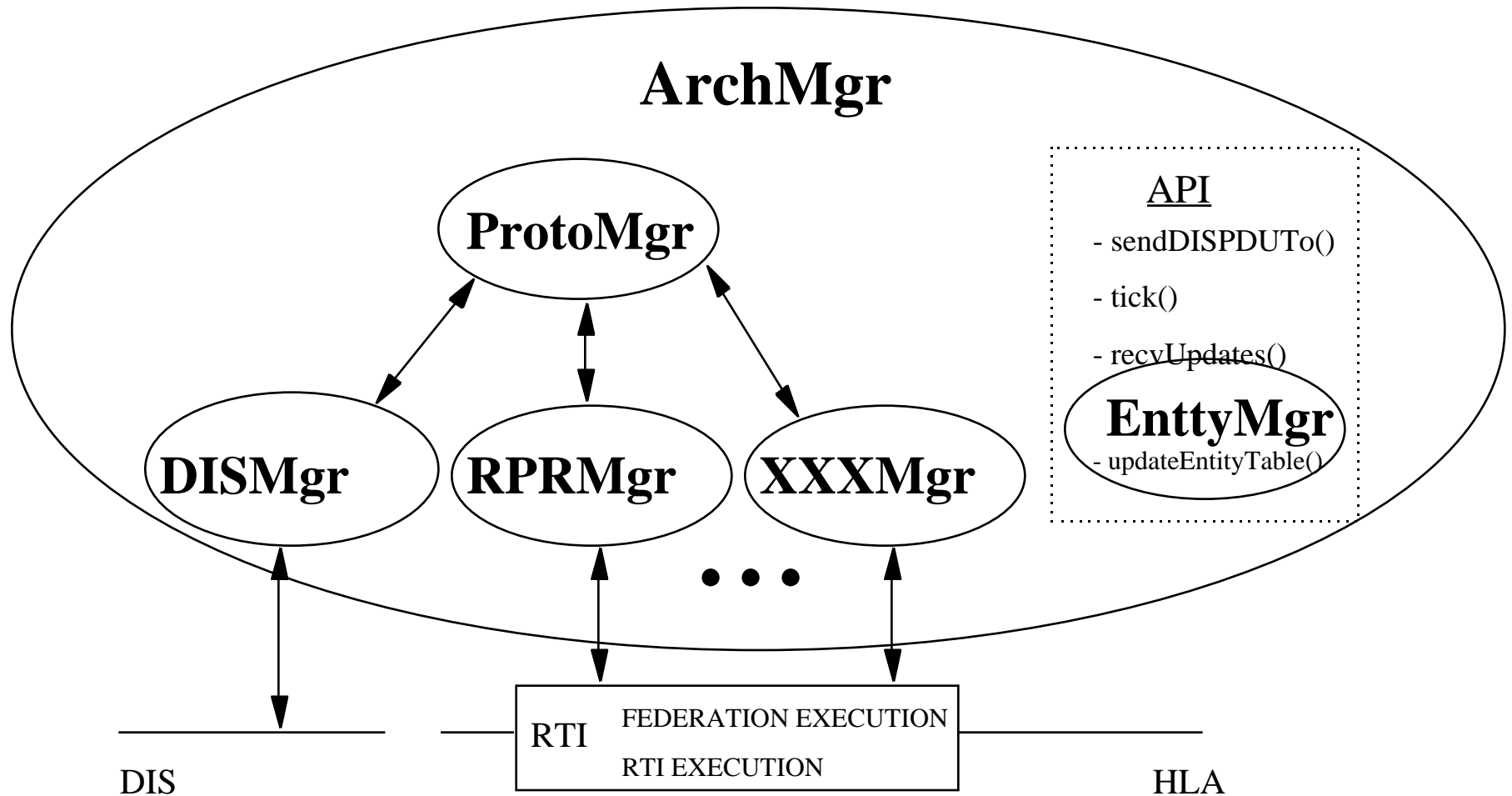- F-18

SMOC

RTI

- F-14

SMOC

RTI
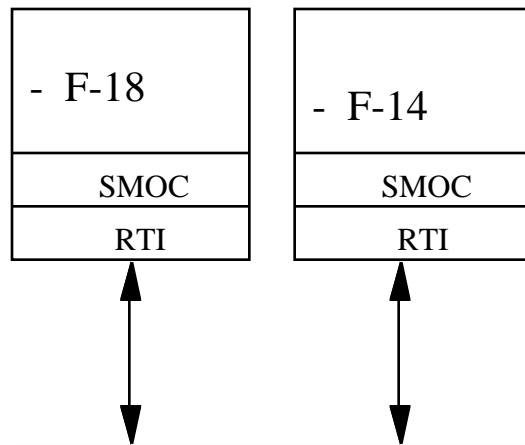
Network

Network

NAWCTSD SIMULATION MIDDLEWARE OBJECT CLASSES (SMOC) ARCHITECTURE

- Approach taken based on Lessons Learned from first implementation and looking at future needs of our community.

- Reused code from first implementation, but focused on O-O design approach.

- Tried to implement higher degree of reusability, flexibility, and scaleability

NAWCTSD SIMULATION MIDDLEWARE OBJECT CLASSES (SMOC) ARCHITECTURE

- **Object Oriented/Modular Interface**

- **Realtime Platform Reference Federation Object Model (RPR-FOM) used with extensions for Voice.**

- **DIS and HLA interface in a single box**

- **Developed for Windows 95/NT, HP-UX, Solaris, and IRIX.**

- **RTI 1.0 and HLA Tools all supported**

NAWCTSD SIMULATION MIDDLEWARE OBJECT CLASSES (SMOC) ARCHITECTURE

ArchMgr

ProtoMgr

DISMgr   RPRMgr   XXXMgr

API
- sendDISPDUTo()
- tick()
- recvUpdates()

EnttyMgr
- updateEntityTable()

RTI   FEDERATION EXECUTION
RTI EXECUTION

DIS

HLA

NAWCTSD SIMULATION MIDDLEWARE OBJECT CLASSES (SMOC) ARCHITECTURE

- **Different FOMs supported**
  - **Architecture data file supports the idea**
  - **Requires development of new object class for each FOM type (RPR-FOM already implemented)**
  - **Software "Knows" through polymorphism which instance to choose**
  - **No existing lines of code get changed**
  - **Supports exercise scaling as user can specify which channels data is sent/received on**
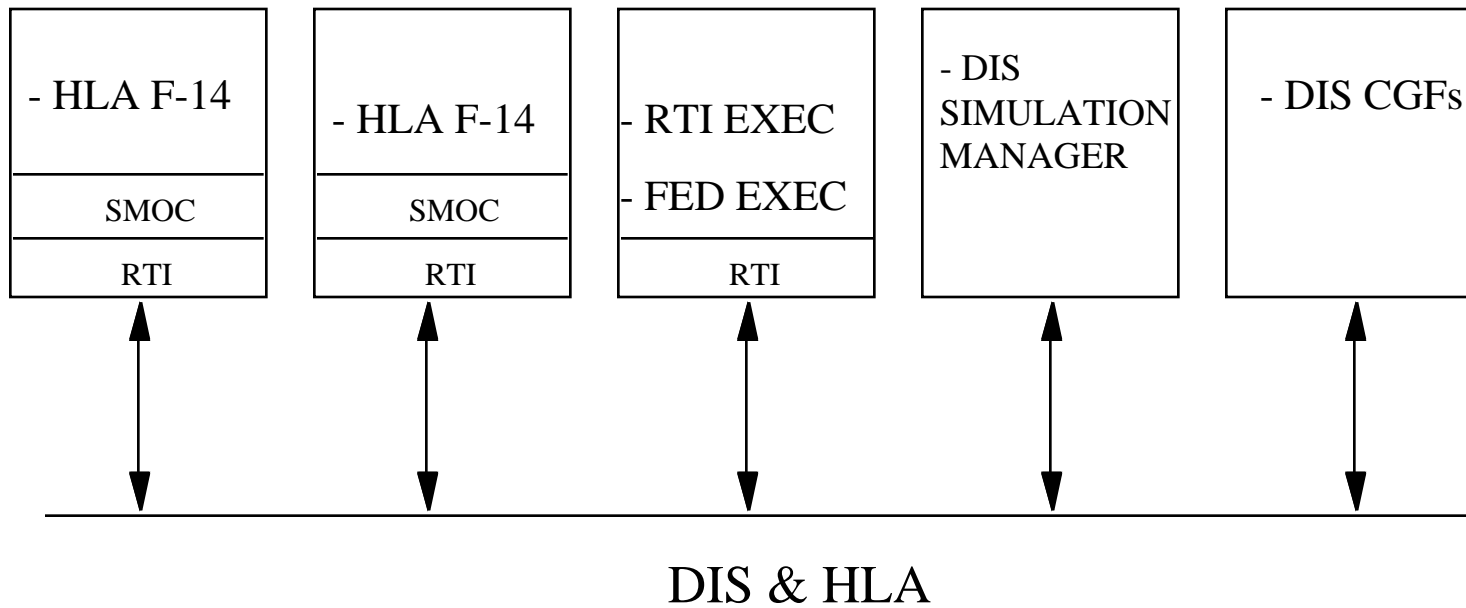
SMOC USES

- **Quick solution for a DIS-HLA migration (Gateway mode)**
- **Solution for interoperability (Use of RPR-FOM)**
- **Solution for existing trainers (No DIS) with middleware mode**
- **Solution for running DIS and /or HLA exercises without recompiling code or using a gateway**
- **Solution for Multiple FOM interoperability**
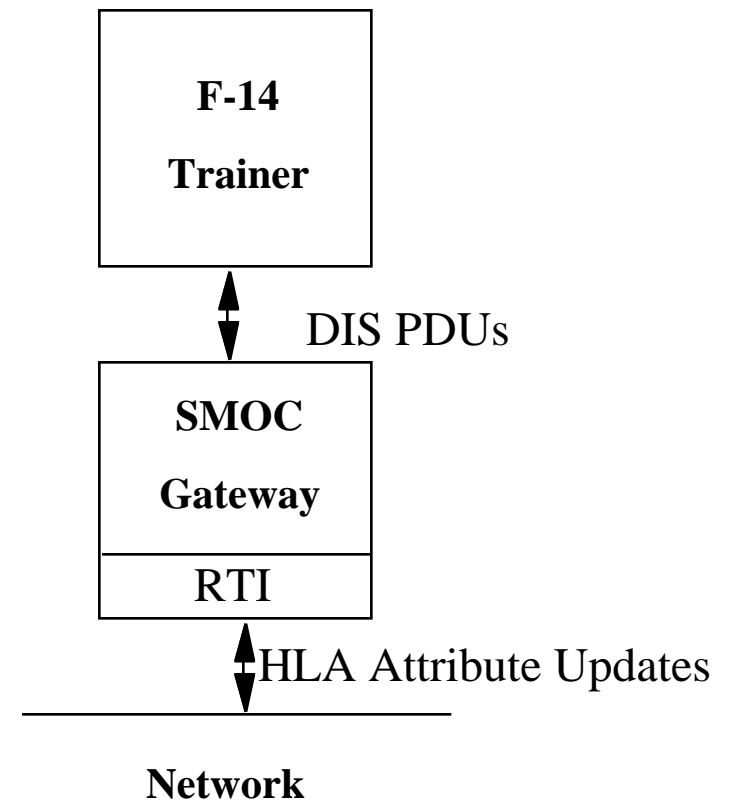- **Solution for multiple RTIs**

Testing

- **Testbed application at NAWCTSD**
  - All federates and entities on a single physical network but using different channels
  - Two F-14 simulations use the SMOC to interact
  - CGF entities and DIS manager also interacting
  - F-14s see each other and all CGF entities
  - Can support all DIS and HLA combinations (2 HLA F-14s, 2 DIS F-14s, 1 DIS and 1 HLA F-14) all interacting simultaneously.
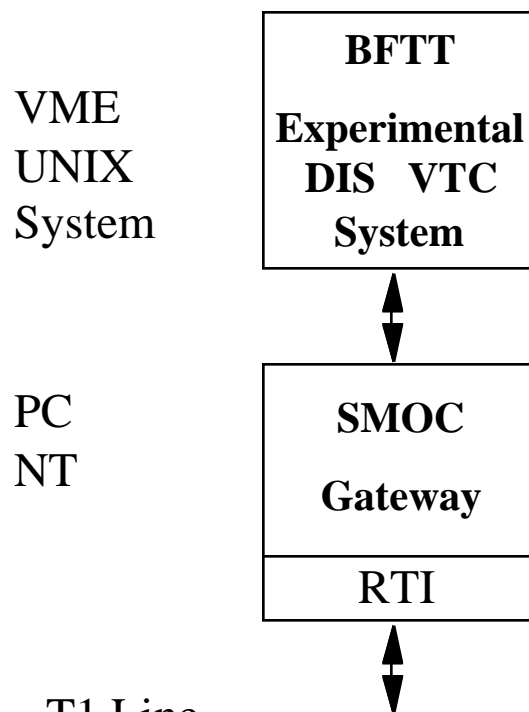
Testing

- HLA F-14	- HLA F-14	- RTI EXEC	- DIS SIMULATION MANAGER	- DIS CGFs
SMOC	SMOC	- FED EXEC		
RTI	RTI	RTI		

DIS & HLA

Testing

- **SMOC Performance in Gateway Mode**
    - **Delay of less than 3ms for small number of entities and objects**
    - **Latency went up as number of entities and objects increased.**
    - **At 100 attribute updates/sec HLA to DIS latency increased to around 14ms. For DIS to HLA latency only went up to around 5ms**

F-14

Trainer

DIS PDUs

SMOC

Gateway

RTI

HLA Attribute Updates

Network

Testing at I/ITSEC

USS THE SULLIVANS - Mayport

MARRIOTT - Orlando

VME
UNIX
System

BFTT

**Experimental
DIS   VTC
System**

BFTT

VTC

DIS PDUs

PC
NT

SMOC

Gateway

RTI

SMOC

Gateway

RTI

T1 Line

WAN
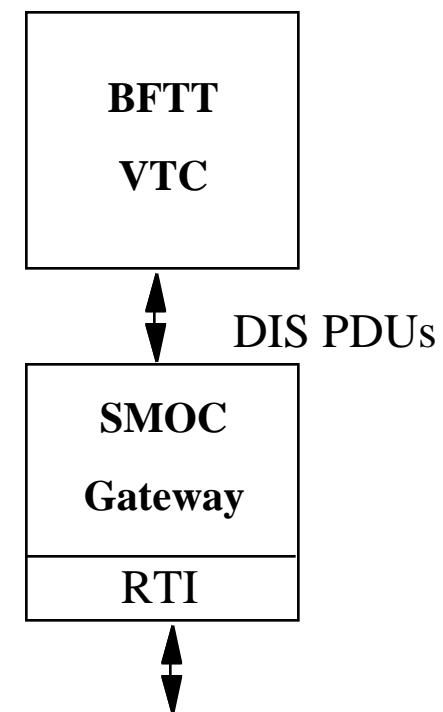
Testing at I/ITSEC

ARC Dome - Booth 302 I/ITSEC

NAWC Booth 536 I/ITSEC

| Heads Down PC-NT | **F-18** **SMOC** **PC-NT** RTI | Flight Model RTI/Fedex | Flight Model RTI Heads Down Display | **F-14** **SMOC** **PC-NT** RTI |

DIS

HLA **Network**

| ONYX2 VISUAL | | BFTT Digital VOICE | BFTT Digital VOICE | DIS |

| DEC-ALFA IOS SIM-MAN AAR | | SGI-O2 IOS SIM-MAN AAR | SGI-O2 Visual | |
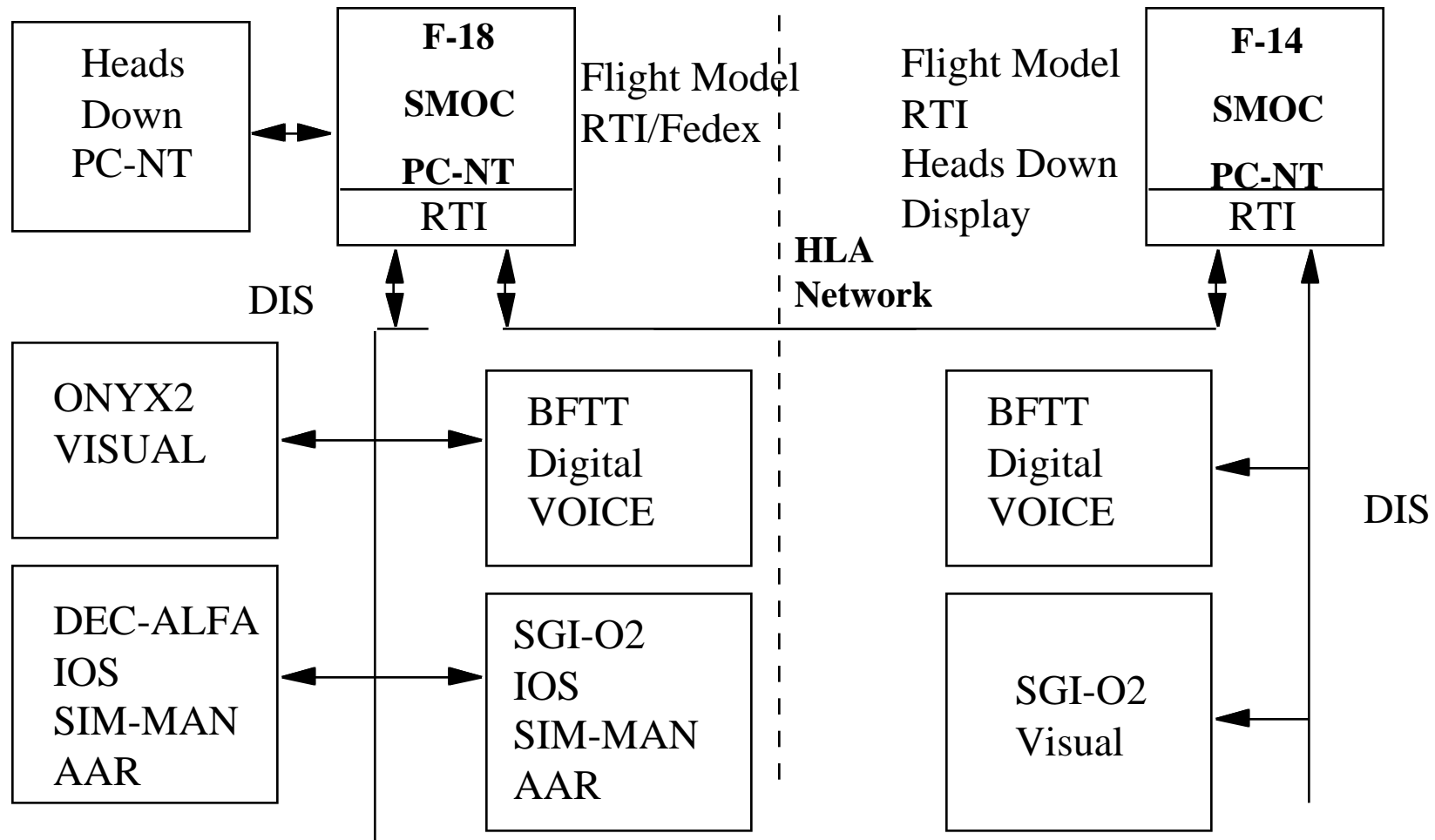
Testing

- **SMOC Performance in Gateway Mode**

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    - **Test for Voice throughput (Signal PDU) allowed near-real-time delivery of audio through the HLA with no perceivable delays.**

    -

    - **Test for Video throughput allowed for near-real-time delivery of Video through the HLA with no perceivable delays**

Summary of Lessons Learned

- **RPR-FOM**

    - **Point of departure for DIS compliant systems**

    - **Provides for reuse of DIS Data structures**

    - **RPR-FOM is evolving to meet the needs of former DIS users**

- **OMDT Development Tools**

    - **Replaces a hand written FED file and provides invaluable consistency checking**

    - **Consistency checker does not always provide an error message**

    - **Need to be able to set global values (Reliable vrs best effort) as default value and when a global change is required.**

Summary of Lessons Learned

- **RTI Integration**

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  - RTI F.0 limited the size of an individual attribute to 512 bytes.

  -

  - Found that in using Windows NT, an interval timer to allow for dead reckoning did not work. We fixed this by removing the interval timer and adding a delay of 33ms between each loop.

  -

  - Found that our PCs could not reflect attributes or interactions to other PCs if sent "Best Effort". Problem fixed when changed to "reliable".

Summary of Lessons Learned

- **RTI Integration**

  - **Found the NT development environment to be more expensive than 95.**

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  - **(RTI 1.0) Found that if you receive a stack overflow exception, you just need to increase the default stack size to 2 Meg.**

Milestones

- **Analysis of DIS and HLA specifications and protocols (2/97 to 3/97) COMPLETED 3/97**

- **Continued rehost of F-14 simulator to NT platform (2/97 to 7/97) COMPLETED 6/97**

- **Received RTI F.0 for SGI and SUN from DMSO (3/97) CLOSED**

- **Obtain RTI 1.0 for NT/UNIX from DMSO (5/97) CLOSED**

- **Conversion of F-14 simulator to HLA compliance (4/97 to 11/97) COMPLETED 11/97**

- **Interim Report #1: Pre-Implementation (5/97) COMPLETED 5/97**

- **Interim Report #2: Implementation (9/97) COMPLETED 9/97**

- **Final Summary Report: Post-Implementation (12/97) COMPLETED 12/97**

➡ HLA gateway program is on schedule